application or any patent issued thereon.

First Inventor's signature _____ Date _____

Michael Novosel

Second Inventor's signature _____ Date _____

Kelly Boles

Third Inventor's signature Vincent S Fleszewski III Date 3/28/02

Vincent S. Fleszewski, III

APPENDIX A

a - Letter from Mike Novosel to Kelly Boles, Nov. 6, 1994

b - Letter from Mike Novosel to Kelly Boles, circa Nov. 12, 1994

APPENDIX A

a - Letter from Mike Novosel to Kelly Boles, Nov. 6, 1994

b - Letter from Mike Novosel to Kelly Boles, circa Nov. 12, 1994

c - Advertisement, page 161 of *Model Railroader*, February 1195

d - Review, *Model Railroader*, October 1995

e - Letter from Mike Novosel to Attorney of Record, Oct. 6, 1994

f - Letter from Mike Novosel to Kelly Boles, Sept. 5, 1994

g - Letter from Kelly Boles to Mike Novosel, Sept. 22, 1994

h - Letter to Mike Novosel from Kelly Boles, Oct. 5, 1994

i - Letter to Mike Novosel from Kelly Boles, Oct. 14, 1994

j - Letter to Mike Novosel from Kelly Boles, Oct. 31, 1994

k - Letters to Mike Novosel from Kelly Boles, Jan. 3 and 17, 1995

l - Letter from Mike Novosel to Kelly Boles, Jan. 1994

m - Record of Invention to Attorney of Record, Sept. 23, 1994

n - Record of Invention to Attorney of Record, Aug. 4, 1995

Kelly 4

circa Nov 2-6, 1994

November 6

Kelly,

Glad to hear from you with your progress report. Its strange, but I look forward to these. You will find in the envelope a disk of the dual sound board, and the challenger instructions. I sent the dual board file just in case you may want it.

I believe you are on the correct course, however I have a couple of questions/ thoughts.

The First thought on the theory of operation is the dip switch. My understanding of its prupose is to give the sound boards addressing a measure of flexibility.

If my statementis correct, on the dual sound board we can have hard address lines to the ISD chip. We will only want to access two-three sounds. These would be a bell, horn and a combination of the two possibly. While also giving the analogue use access to two sounds.

Saving multiple adressing for the full board. Featuring throttle-up, bell, and horn, etc for phase 3. The Dip switch may be the means to accomplish this. Obvioulsly elimiantion of the dip switch will make the board layout much easier in the Phase 2 configuration, maybe the board my be made for multiple uses. Your thougts would be apprecated.

The other question is why include fuses on the PC board. The level of protection offered is a very good idea, but would the powersupply or DCC command station offer the same protection. Perhaps I should nake a quick survay on the time delay of the DCC short circuit protection? This would give the answer, my other concern is keeping the cost down, I realize the fuses cost pennies compared the problems of returns and the initial cost of the product. you could be correct for their inclusion.

The inclusion of a analogue method for triggoring the board is a great idea! Given the original design parameters for DCC compatiblity. I have one question about the optoisolator. Is the optoisolator simply acting as a spst switch or needing a active input to turn the switch to a on position?

Concerning your two questions relating to the power switch and wheel sets.

The power switch may be eliminated.

item a

As to a wheel set selection or recommendation for improved electrical performance there are two. The first is for the end user to purchase a set of Northwest Short Line nickle silver wheels for their diesel dummy or rail car containing the sound unit. With the additional suggestion using Tomar or equivalant pick shoe to aid in electrical pick-up.

There would be no objections to dividing the board into stacking units. Especially if it could be done so there is a sound storage compander amplifing unit. DCC booster, external triggor and power supply section. I am not sure this division is the most logical when examing the amount of PCB traces to get from one section to another. This will take a little more thought to do.

This scheme could possibly then make the phase 3 full locomotive sound system easier to develop. Because, then only a expanded means of adress lines and a way to sync engine sounds would be required, so maybe the dip switch is a good idea? The full sound system could need two ISD SMT type chips to combine the sounds of different engine reves and warning sounds.

My only objection to using SMT devices would be if there is a huge cost difference. The only way to make this determination is to compare costs. Maybe the best of both worlds could be used if stacked boards are used and one uses SMT, say the audio section and the other DIP components. Using the DIP on the board common to Phase 2 and 3 may help with the cost problem?

If you provide me with a componet list and quantity I would be happy to investigate the cost comparison.

We have made a decision to concentrate on the DCC compatiblility first, you seem to have a good grasp on how to make this work. At this point should we look for a moment on how to triggor this using a RF input for the warning sounds or will the external trigger satisfy this need.

I have also obtained a Ott sound system and controller for you, please advise me when you are ready to recive this to determine the Lionel/ Ott method of triggering the warning sounds. Perhaps this will be a moot point if the RF method could use off the shelf FCC licensed products.

Two last thoughts one is where are we on expenses, ie do you require more money for expenses. We have come to the end of the first month of development and at some point I would like to look at recepts to know where I am at expense wise.

Mike

performance of the system. I am in the process of installing some Nickle Silver wheel.

Atlantic Coast Line track plan by John Armstrong

Model Railroader

FEBRUARY 1995
$3.50
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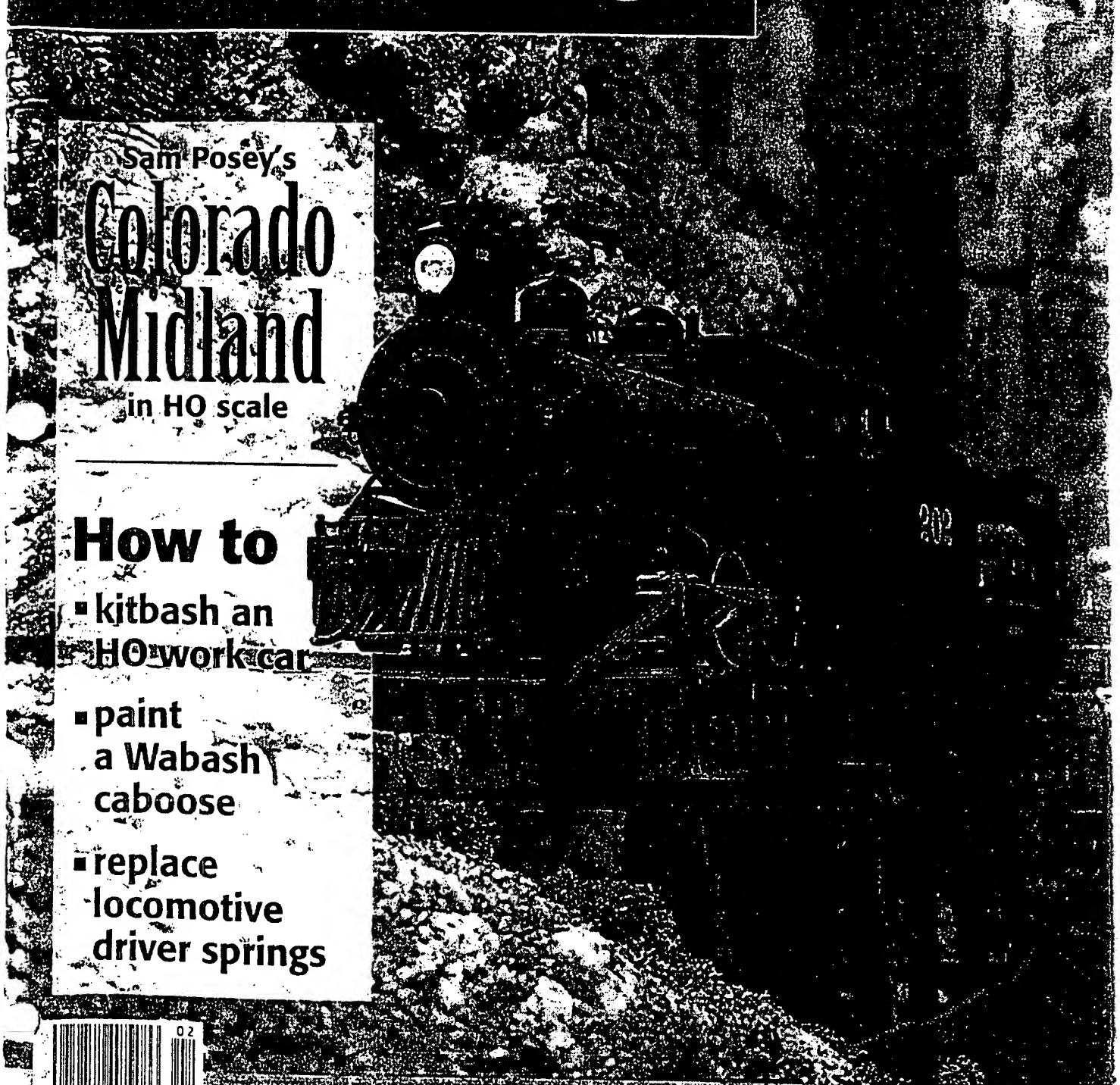
Build a coal mine in N scale (and HO too)



Sam Posey's
Colorado Midland
in HO scale

How to

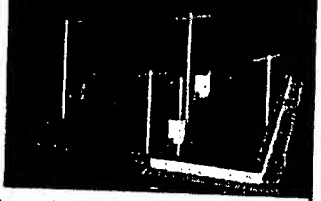
- kitbash an HO work car
- paint a Wabash caboose
- replace locomotive driver springs

0 74851 08548 02

Scale drawings of Lincoln's funeral train

item c

CABOOSE DETAIL SETS
IN N-SCALE! LOW COST – EASY TO INSTALL – NO SPECIAL TOOLS REQ'D



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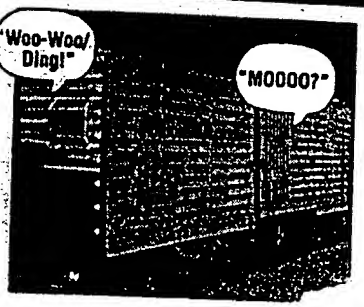
New from the makers of

LIVE STOCK...



It's *PRIME MOVER 2*
the DCC Compatible, dual sound module.
Coming Mid Winter!

LIVE STOCK isn't synthesized but comes "straight from the horses mouth"! Choose from: moos, oinks, nayes, baas, elephant trumpets, tiger growls, and train sounds.

Specify sound when ordering. S&H $5.75. IL residents add 8.75% tax. 4-6 weeks delivery.

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Call (312) 202-9931 and ask for Mike or write: Real Rail Effects, Inc., P.O. Box 1627, Highland, IN, 46322

N Y6b Mallet 2-8-8-2 Heavy Freight Steam Locomotive

CON-COR

READY TO RUN

During World War I, the United States Railway Administration (USRA), drew up plans for a series of locomotives to be built for the American railroads by "mass production" process to aid in the war effort. This type became commonly know as the USRA design, and all became very popular with roads that used them. One of the many designs was for a compound Mallet steam engine with a 2-8-8-2 wheel arrangement. This superb reproduction belongs at the head of your heaviest freights!

Con-Cor is announcing the production of an all new run of the popular 2-8-8-2 N scale Mallet! These large locomotives are among the biggest ever built by the railroads and were often seen pulling long strings of coal hoppers as well as long mixed freights. This run of Mallets will feature upgrades to improve operation and pulling power. Manufactured by Rivarossi for Con-Cor this run will cover the most popular roadnames as well as the limited number of undecorated units so you may decorate them for your own private or class one road. *Hurry!* Next run not until late 1997 or early 1998.

Con-Cor 'N' Scale 2-8-8-2 MALLET
(Due early '95)

0001-03201A	Undecorated	No paint or decorations	$259.98
0001-03201B	Santa Fe	Black with White Numbers	$259.98
0001-03201C	Pennsylvania	Black with White Numbers	$259.98
0001-03201D	Norfolk & Western	Black with White Numbers	$259.98
0001-03201F	Union Pacific	Deluxe paint scheme	$289.98
		Silver smoke box	

JMC

JMC International

Prototype

Model Railroading Takes a Closer Look at Digital Command Control

Part II

Last month we began what we hope will be a continuing series of articles on various aspects of Digital Command Control (DCC), the frequency of which will depend entirely on the speed at which this new aspect of the hobby develops. This month I have a couple pieces of unfinished business to go over, then we'll take a look at one of the first new products available among an expected boom in DCC peripherals, and finally I'll get to the list of manufacturers.

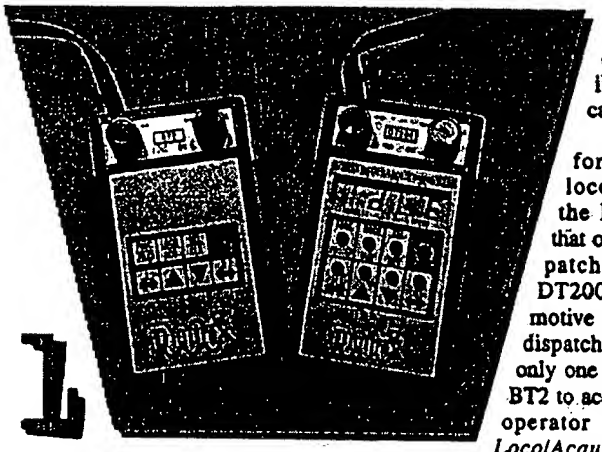
by Larry Puckett

Photos by the author

Digitrax

Due to a foul-up by one of the overnight delivery companies a Digitrax BT2 "Buddy Throttle" wasn't available for my evaluation last month, however I've now given it a workout and wanted to give you a little more information on it. As you can see from Photo 1, the BT2 is similar in size and configuration to the DT200, the most obvious difference being the lack of a digital readout. The BT2 is designed as a dumb throttle that can access and control two locomotives or consists simultaneously — it cannot program decoders or control stationary decoders, but it can control the decoder functions such as lights, bell and horn.

The speed-control knobs (binary encoders) have a built-in acceleration feature that works sort of like the rate at which your mouse moves across your computer screen. This allows you to advance through the entire 128 speed steps in about one revolution compared to five on the earlier DT200 I have. If you turn the knob at a normal steady rate it can take five revolutions, but if you give it a quick turn it will advance through the speed steps much faster. This is a big advantage, making it much easier to make a panic stop. Like the DT200, the BT2 requires a 9V battery, but the battery should last 300-400 hours. The other big advantage of the BT2 is its cost — it is about half the price of a DT200 so all of your operating "buddies" can have one.



The procedure for accessing a locomotive with the BT2 requires that one first be dispatched by the DT200 — the locomotive or consist last dispatched will be the only one available for a BT2 to acquire. The first operator to hit the *Loco/Acquire* and direction key on a BT2 will be the one to acquire the last locomotive/consist dispatched. In operating sessions the yardmaster/hostler can use a DT200 to build a consist and couple it to a train on the departure track, then dispatch the consist to the system where the engineer would use his BT2 to acquire the consist before leaving the yard. Try one out at your local Digitrax dealer.

Before I get some letters I also want to make another point clear about the Digitrax Big Boy™ system. Because one DT200 must serve as the master controller for the Big Boy system, it cannot be disconnected from the system at any time. Other DT200s or BT2s can be disconnected and moved around the layout. Consequently, for walk-around operations you must have another DT200 or BT2 throttle. This will be eliminated in the future release of the DCS100 — a master control station with its own 5 amp booster. Both DT200 and BT2 throttles will be compatible with the DCS100 and all throttles will be used for walk-around operations.

Digitrax has also released a new keypad for the DT200. The old keypad is like the one on the BT2 shown in Photo 1. It is similar to keypads on microwave ovens, and doesn't provide positive click feedback when a key is pressed. The new keypad consists of an adhesive overlay that replaces the old one plus eight small round plastic keys. Upgrading takes about five minutes and is accomplished by peeling off the old overlay, setting the keys in place, and then applying the new overlay. The difference is amazing — you get an almost immediate response and a positive click so you know when the button has been pushed far enough. The new keypads are available only from Digitrax for $7 — a similar upgrade will be available soon for the BT2 throttle.

Real Rail Effects

The new DCC standard is expected to result in a new cottage industry of spin-off products and peripherals. One of the first I have seen is the Real Rail Effects **Prime Mover Phase II Sound Module** shown in Photo 2. Prime Mover provides three basic sounds — bell, whistle/horn and diesel or steam engine sounds (I tried out their diesel sound module), as well as functions 0 and 1 which commonly are used for headlights. The functions and sounds are activated using the function buttons on DCC throttles.

You control Prime Mover using any of the 63 possible addresses that are set by inserting diodes (several are provided) into a socket on the board. You can give it its own address or set it to the same address as a locomotive. At first I thought that two digits and 63 addresses was a limitation, however by adding the sound module address to the locomotive as a consist you can control it while still using advanced three and four digit addresses. Because it has its own built-in decoder circuit, it can function in stand-alone mode or installed in a locomotive.

Installation is very easy, just attach the red and black wires to right and left rail contacts in a locomotive, dummy engine or car or to the main bus wires under the layout for stand-alone installations. You do have to make sure it is isolated to prevent shorts, but it is fused, and if you manage to smoke it, Real Rail will repair it for a fee. If you install it in a dummy engine or rolling stock you will need to run a jumper to the locomotive or install metal wheels for electrical pickup.

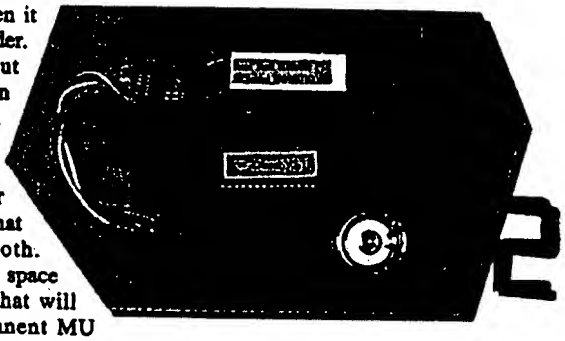
Prime Mover uses the same sound chip available at Radio Shack but has a lot of sophisticated electronics packed into its .78" x 4.20" x 1" board. Also, as new versions of the sound chip become available it can be replaced easily (I installed Version 3 in a couple minutes). The sounds are very good because they are digital recordings of the real thing, not electrically generated. Unfortunately the chip can only play back one sound at a time with the horn having first priority, then the bell, followed by the engine sound. The horn can be activated as individual blasts, or by holding the button down it will give the familiar long, long, short, long crossing signal. Because these are digital recordings being played back, the engine sound has to be divided into several (five in Version 3) discrete levels which increase in volume and pitch in response to the increasing speed steps on the throttle. This is similar to the way a real locomotive revs up as the engineer advances the throttle through each of the eight notches.

The bell and horn are especially clear and distinctive because of the high frequency of those sounds compared to the lower frequency bass of the engine noise. Those small 1" speakers just don't provide a lot of low frequency response. One way to boost bass response is to add a sound box. I made one by cutting a 1" diameter pill bottle in half and gluing a thin piece of styrene over the cut end. When you slip the open end over the speaker it will really boost volume and bass response, and you can't beat the price.

With the rather large dimensions I gave above, this unit will only fit in HO cab units or other wide-body locomotives like the Train Master or early GP units produced before Athearn went to scale-width hoods. For more modern settings it could go in a fuel tanker like those used on the BN or CSX, or the first car behind the motive power. Another option is to install it under the layout and use a really big speaker for ear-splitting effects! We've done this under the main yard at our club, running the output through an amplifier and 8" speaker. People in the parking lot were looking for that phantom locomotive. This really is the only option for N and smaller scales. A really nice 1" diameter speaker is included. Volume can be controlled using the small pot on the board. Contact Real Rail Effects, P.O. Box 1627, Highland, IN 46322 or call Mike at (312) 202-9931 for more information and current prices.

Coming Attractions

Next month we'll take a look at stall currents for an assortment of HO-scale locomotives and discuss how they are measured and just what that means when it comes to selecting a decoder. While we're talking about decoders I'll fill you in on the whole story behind the Atlas DCC plug problem, tell you how to fix the Life-Like resistor problem, and tell you what you can expect from both. Finally, if there's enough space I'll show you a circuit that will allow you to run permanent MU lashups with only one decoder. In December we'll talk about power supplies and wiring layouts for DCC operations.



1 The Digitrax BT2 "Buddy" throttle on the left has the old-style keypad whereas the DT200 on the right has been upgraded with the new round-button keypad.

2 Real Rail Effects' Prime Mover II Sound Module is shown here with the 1" diameter speaker provided with it and the sound chip.

DCC Sources

Arnold
Prugh Investment Corp.
Suite 110
15200 US 41S
Ft. Myers, FL 33908

Digitrax
P.O. Box 1424
Norcross, GA 20091

Electronic Rail Products
113 Betty Spring Road
Gardner, MA 01440

Lenz
PacRail Imports
116 Edgewood
Pacifica, CA 94044

Lenz
SMW
319 Robinson Lane
Wilmington, DE 19805

Lenz
TRAXYS Plus
P.O. Box 37772
Cincinnati, OH 45222

Märklin
P.O. Box 51319
16988 West Victor Rd.
New Berlin, WI 53151

Model Railroad Digital Industries
4832 Lakeside Dr.
Colleyville, TX 76034

Quest Management
8900 Birch Wood Lane
Bloomington, MN 55438

Railhead Digital
2600 N. Carroll
Southlake, TX 76092

Raytec
P.O. Box 4013, S-182 04
Enebyberg, Sweden

Trix International
Railtech Inc.
P.O. Box 691
231 Main St.
Manchester, MI 48158

Wangrow Electronics
P.O. Box 98
Park Ridge, IL 60068

Wolfgang Horn
Garwiedenweg 16
D-7778
Markdorf, Germany

Table — Sources of DCC-compatible command stations, complete systems and decoders. Some companies may not have a product in production yet but have announced an intent to do so.

6 October 1994

Brian Mattson Esq.
Hill, Steadman, & Simpson
Sears Tower
Floor 85
233 South Wacker Drive
Chicago, IL 60606

Dear Brian:

The following is a brief description of a model train sound system currently being developed by Real Rail Effects, Inc. Upon your review, please include this document in Real Rail Effects' file at your firm to indicate date of inception and record of invention.

This device is for a model train sound system. The system will be composed of the following parts:

A circuit to rectify and regulate AC or DC power. This may include a power supply compatible with any sound system circuitry needing 5 volts DC.
A means to store audio data, play the information, and expand the dynamic range of the data.
The use of a micro-controller to access and trigger the sounds.
A means to synchronize the sounds to the speed of the train.

There are existing sound systems on the market. One such manufacturer is Ott Machine Works. Their system uses an ISD Chip and a micro processor to produce synchronized and non-synchronized sounds. This product allows one to match model train sounds to the speed, location and direction of the trains.

I feel that a design limitation is contained within Ott's product. When one sound effect is added on top of another the speed and intensity of the sounds are effected.

The following is a list of the major differences in the sound device of Real Rail Effects, as compared with all other existing sound systems:

Most model train sound systems are homogenous in nature: i.e., when the system is expanded, it can only be expanded with components of the same manufacturer, instead of having the ability to interchange brands. RRE's sound system will include components which will inter-face with almost any method of train control (i.e., "Lionel-style" of sound control, digital command control, radio control, infra-red), through the use of the appropriate soft-ware.

item e

Major differences con't:

- Ott uses one sound chip to hold all sounds. RRE will utilize up to three chip dies, each containing a separate sound library, directly mounted to a PC board. This allows the sounds to operate independently or in unison.

- Most sound systems use only one method of triggering the sound. RRE's activation method will involve computer software which will be programmed into a chip. Varying the chip's programming will determine the method of activation and make the sound system compatible with other manufactures.

- Most sound systems are larger in size. RRE's sound system will fit most popular model train sizes (gauges) and may be installed in other locations not presently able to be outfitted with sound.

I hope this provides enough information to establish date of inception for this new product. If you have any question please feel free to call me at 312/202-9931.

Sincerely,

REAL RAIL EFFECTS, INC.

Mike Novosel
President

Real Rail Effects, Inc.
P. O. BOX 1627 HIGHLAND, IN 46322
312/202-8931

MIKE NOVOSEL
PRESIDENT

FEC EA
135 8880 10

NMRA 892-2046

September 5, 1994

Hey Kelly. It was nice talking to you again. If you recall, we spoke briefly about the product that I've been marketing for the past year. Enclosed please find the information to which I was referring.

I hope you don't mind me contacting you; due to the loss of my technical partner, I need assistance in developing my product further. I remembered your technical and design knowledge from our working past and thought I may be able to contract your services.

The enclosed information is used at trade shows and is geared to "Joe Consumer". I also included information on our competitors products and an explanation of command control systems. I hope this will give you a idea of the technology that is available currently to the mass market.

I currently need assistance to create a syncronized sound system that would contain various sound effects found on a real locomotive. I need a universal product for use in a broad range of scales and that would intigrate with various method of model train control. QSI and OTT are bench mark products but are only targeted for AC/Lionel style trains.

Based on a mutual interest, I hope you will consider this a worthy use of your skills and time. If interested, please advise me as soon as possible and we can work out the details. I need to move forward quickly due to repeated inquiries from manufactures at the just concluded NMRA convention.

I have design parameters and a sample of OTT's sound system to aide in the design of this new product. Ott uses the same chip as we currently use.

If you have any questions, please feel free to contact me. As you probably may have concluded, the premise for this new product is conidential information, so mum's the word.

Thanks man,
Mike Novosel

Mike Novosel

item f

September 22, 1994

Michael Novosel
Real Rail Effects
4220 N. Marmora St.
Chicago, IL
60634

Mike,

The following is a proposal to accomplish the following:

1. Design of a new sound board with a flexible addressing scheme to allow variations in the number and the duration of the sound effects generated. The input of the board will allow different control options via the use of daughter boards. (e.g. Manual, DCC, Lionel / OTT, RC, or others.) { Lionel / OTT, RC future designs }

2. Design of a DCC compatible decoder and software which will provide up to 8 outputs for use as discrete switches or as address lines; along with manual input triggers.

3. Design and fabrication of PCB's for both the new sound board and the DCC decoder (or a single board if they should be combined).

I believe enough research has been completed in order to begin to narrow down hardware designs and cost estimates.

I'll begin with the DCC decoder.

The DCC decoder requires a processor as it must be able to decode addresses, data, and error detection byte packets as defined by the NMRA. It also must meet the physical requirements of the limited space available.

Typically when production runs are limited and space is not an issue, the software would be stored in an EPROM. A typical processor has 40 pins and a typical EPROM has 28 pins. You also need a few other chips (one 20 pin, one 16 pin, and one 14 pin) for "glue logic" to logically connect the processor to the EPROM. Additionally a Watch dog timer is used to prevent processor lockups and with DCC at least one comparator chip to act as inputs for the DCC would be required. The current 40 pin processor I use in non-space critical designs is the Z86C91 from Zilog. The main feature to Zilog's micro controllers is they use general purpose registers (instead of an accumulator) that can be grouped as working register groups. This helps facilitate the movement of blocks of data often found in process control and in your application. I have previously used this processor in infrared control systems, animated neon signs, video switchers and a Class IV laser projector.

item g

I have omitted some other required parts for the clarity of this example, but the pin count with the parts listed above would be:

MPU processor	40 pins
EPROM	28 pins
add latch	20 pins
add decoder	16 pins
ALE inverter	14 pins
Watch dog Timer	16 pins
Comparator	14 pins
Total	148 pins

This is a very flexible design which has allowed me versatility in my design applications but is not very "real estate" conscious.

This would be able to decode DCC but *would not* fit into a HO 40' scale stock car.

However; in an application specific design such as yours, Zilog has a smaller version of the Z86C91, the Z86C08.

This is a 18 pin processor with virtually the same features (plus more) and instruction set as the 'C91 in a smaller package. It also contains the program, Watchdog timer, and 2 analog comparators on board eliminating the external EPROM, Watch dog timer, comparator and associated logic. The Z86C08 is available is available in a SOIC (Small Outline IC) surface mount package and has a programmable low EMI operating mode.

When comparing the 18 pins of the 'C08 and the pin count listed above of 148 pins there is a net savings of 130 pins. The trade-offs of the smaller processor when compared to the larger processor is no serial port, less I/O lines, less memory addressing capabilities. None of these are required by your application.

This processor and associated parts required for DCC *should* fit into a HO scale stock car or Loco dummy.

Once the software is perfected it can get programmed onto the chip in one of 2 ways. If you anticipate production runs greater than 10,000 pieces, you can have the factory mask the program on your parts. There is a $3000.00 initial set-up charge. This method would net you your lowest cost per piece.

For production runs of 100 to 9999 pieces, Zilog makes another version of the Z86C08, the Z86E08. This chip has its programmable memory arranged as one-time programmable PROM. This allows a practical means for a manufacturer with PROM burning capabilities to load custom programs into the processors for limited run productions. These processors also provide for copy protection enable which will not allow external attempts to read the program from the chip.

The software for the DCC decoder will be flexible enough to evolve with the transmitters available from manufacturers and the extent of their support for both the baseline standard and extended control. At some point in the future, peripherals (such as sound boards, turnout motors, signals etc.) will obtain their control from DCC transmitters which offer extended control. I'm not aware of any manufacturers offering such a controller at this time. The availability of such DCC transmitters should be researched further.

However; initially, the sound board will most likely occupy an unused locomotive address in an individuals DCC system. The various data normally associated with locomotive control such as speed, direction, and braking will be translated into controls for the various sounds created.

There are a few extra I/O pins on the processor which would allow manual triggering in conjunction with DCC control. The assignments of the manual triggers and their logical priority are definable in software.

Since this processor is a "little brother" of the Z86C91, I can use the 'C91, assemblers and emulators for the R&D work. Zilog will provide samples of the Z86E08. They will be used when development is near complete as EACH 'E08 can be programmed only once; and any done so in error would be scrap.

A couple other areas of the design will also need to be addressed to make the product complete.

1. The power supply.

The system will most likely get its power from the rails in a DCC system. A significant filter capacitor or Ni-cad battery pack / charging system should probably be included. AC / DC input terminals should be provided for stationary installations.

2. The wheel pickups.

It is important that quality wheel pickups be used and installed properly when power and control is obtained from the rails. Some thought should be given to this aspect as to whether this is a product or installation service you may provide. This is a situation where the term GIGO applies.

Option 2. Down payment / per piece payment.

As a person who shares a similar interest in the hobby; and as person, who after evaluation of your product, believes your product has potential in the marketplace; not necessarily limited to model railroading; I propose an investment / royalty arrangement.

In this arrangement I will defer the majority of an appropriate fee, sharing some of the risk , in hopes of a return on investment.

I would ask for a $750.00 down payment and then receive $5.00 per piece produced.

I would like this arrangement to extend for at least the production of 1000 pieces with the option to mutually renew, cancel or modify based on product performance and our future dealings.

Under either arrangement I would like ownership of the DCC decoder technology to be joint; as at some point in the future I may desire to produce DCC compatible products not related to sound generation. I also understand the proprietary nature of your designs and all submissions will be held in the strictest confidence.

Respectfully Submitted,

Kelly Boles

Enclosures:

Standards for Digital Command Control
Recommended Practices for Digital Command Control

October 5, 1994

Progress Report #1

Hey Mike !

I have analyzed the operation, programming, and data output of the Digitrax Challenger DCC system. Since this is their "entry level" DCC system I assume this would be a product with which you would want to be compatible. The Challenger system does not address the extended function aspects of DCC, so your sound device would have to occupy one of 15 available locomotive addresses. The sound chip could be simply toggled on and off using headlight and reverse light commands or could have a varied response based upon the setting of the throttle. A low setting could cause a few sporadic moos, mid setting more moos, and full throttle the total recording. The Challenger will support either 14 or 28 speed settings which could translate to a similar number (or truncated) of sound effects. The resolution of a 20 sec. chip is .125 sec. with respect to cue points.

I will be returning my CT4 (Challenger) controller when the DT 200 (Big Boy) comes in. (circa Oct. 20) Would you check your pricing on a CT4 as I should probably keep one on hand for future R & D purposes. I will be exploring the compatibility of the sound device with the extended DCC capabilities of the DT 200. It should be a point of research of the percentage breakdown of DCC systems; sold by various manufacturers; as to those which support only baseline packets, and those which have extended capabilities.

The R & D processes have progressed very well. I have completed the basic design of the DCC decoder and have begun wire-wrapping the prototype. I should be ready for the extra parts requested in about a week.

The address of the decoder will be set with a dip switch or similar device. The CVP system uses a similar method to set their addresses. Digitrax controllers will program their loco decoders with an address, but I do not believe we can assume that an end user will have the required equipment to program addresses. Digitrax also requires isolation of decoders for programming. Any decoder on line during a programming session could receive a new (possibly unintended) address. Isolation of a permanently installed decoder would not be practical. Extra positions on the dip switch could also be used to switch between protocols if ROM space allows.

A few comments about the practicalities of compatibility with other protocols. The main focus of the design of this decoder is DCC compatibility; with the potential to interface with other protocols through the use of additional software and or hardware. The other protocols mentioned:

Manual control
Lionel / OTT
RC
CVP

DCC is a bi-polar pulse-width modulated signal. The CVP data seems to indicate that it is also a bi-polar PWM signal. It differs from DCC in that it uses a "mark & count" address scheme where DCC uses an absolute addressing strategy. The hardware would probably remain identical, but would require different software.

Lionel / OTT is unknown at this time.

RC would require the addition of receiver. I am aware of data capable transmitters and receivers which operate at 300mhz. Is it necessary to remain in the 70mhz range ? The receivers would probably have to be modified to fit within a stock car.

Since the DCC decoder contains a processor and can emit EMI / RFI, it may require some type of FCC licensing or approval. FCC licensing would be required for a RC product.

All for now.....

Kelly

October 14, 1994

Progress Report #3

Mike,

After further review, I believe you are correct concerning the necessity of the EOM markers. The message could be started at a random point, but will continue to run until the EOM marker is encountered. You mentioned you had a few dual sound chips programmed that you should probably forward.

Considerations for your next chip burning session:

1. Take the original COW recording and place EOM markers after each moo or stomp.

2. Pace EOM markers after each significant sound in your new recordings.

The processor will recognize the EOM markers and should be able to play the sounds individually or in various (program selectable) sequences. It remains to be seen how smooth the phrasing (random starting & stopping) will be of the ISD chips.

Kelly

item i

October 31,994

Progress Report #4

Mike,

I have enclosed the preliminary schematic for a DCC compatible dual (multi) sound board. This is an advance copy and the design is currently in the prototyping process.

Theory of operation:

1. The address dip switch and the address lines of the ISD chip share Port 2 of the Z86E08. Through software, Port 2 is programmed as an input port for address reads of the dip switch. The address lines are normally held high by RN-1. Transistor Q1 is configured in an open collector "switch" configuration. When "turned on" by a logical 1 on Port 0-0, any address lines closed by the dip switch will be pulled low allowing complimentary address reads. After the address is read & stored, a logic low is output on Port 0-0 "turning off" Q1. The dip switch will float and have no effect on the address lines. Port 2 is then reprogrammed for open-drain output for addressing the ISD chip.

2. To activate a message, the appropriate address is placed on the lines and /CE is toggled by P0-2. EOM is monitored by P3-3. PD is controlled by P0-1.

3. The DCC signal is fed to 1/2 of a dual optoisolator. The output of the optoisolator connects to P3-2 of the processor. The optoisolator accomplishes 2 tasks:

    1. Provides level shifting of the 12-15 volt half wave DCC signal to 5 volt logic levels.

    2. Provides a layer of protection between the processor and external connections.

4. The other half of the optoisolator is used for a voltage-in or pulse stream manual trigger.

5. Fuses (miniature)are shown at the point of rail pickup connection to protect against installation mishaps. The fuses protect the sound board & could potentially protect the DCC booster. (E.g. : Sound board power supply is shorted to freight car metal weight.)

6. The power supply is fairly straight forward.
    Exceptions:

    1. The power switch is omitted; is it necessary?
    2. A 470uf cap has been placed at the output of the 5 volt regulator in order to help stabilize in the event of dirty wheel / track glitches.

Do you have a truck set selected to recommend for use for electrical pickup?

item j

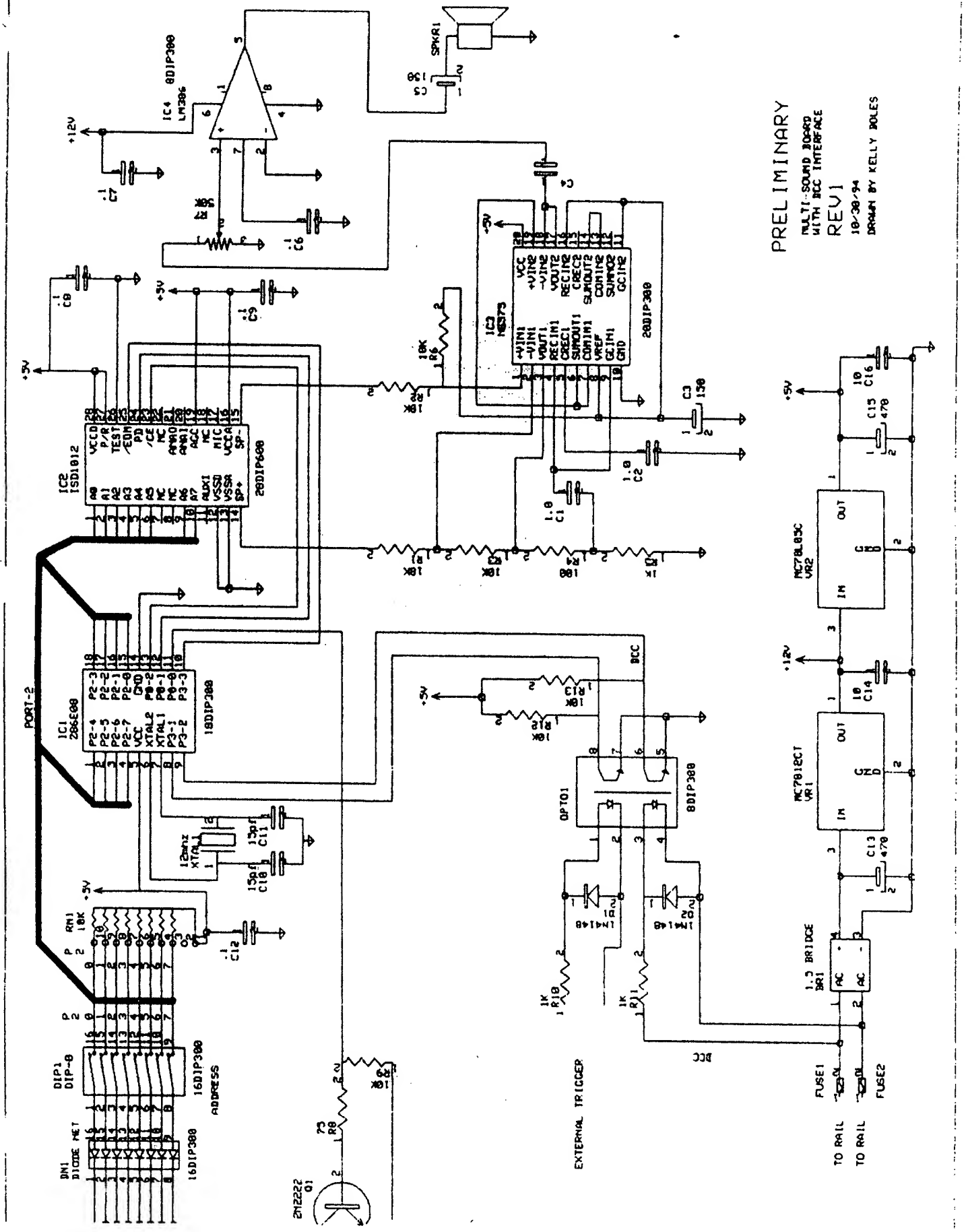
I performed a rough parts layout on a 5.1" x 1" PCB. It looks pretty crowded at this time & will require additional packaging work. (or stacking boards.)

Do you object to using surface mount components?

Smaller
More complex to manufacturer.
Slightly more expensive.

The complexities and additional costs of SMT can sometimes be offset by a smaller package size.

Kelly


PRELIMINARY
MULTI-SOUND BOARD
WITH BCC INTERFACE
REV1
10-30-94
DRAWN BY KELLY BOLES
IC1 286E08
IC2 ISD1012
IC3 MC975
IC4 LM386
VR1 MC7812CT
VR2 MC78L05C
BR1 1.5 BRIDGE
OPTO1
DIP1 DIP-8
DN1 DIODE NET
RN1 10K
SPKR1
XTAL1 12mhz
EXTERNAL TRIGGER
ADDRESS
BCC
FUSE1
FUSE2
TO RAIL
TO RAIL
PORT-2

January 3, 1995

Progress Report #5

Mike,

I have enclosed revised schematics (3A), PCB layouts and cost estimates.

Much of what follows has been discussed over the phone and is restated for reference purposes.

Baseline DCC control of the sound generator has been achieved. As previously discussed a locomotive address is used as the means of identification. The throttle is used as a means of activating the sound.

As it currently exists; when the direction is set in the forward position and the throttle is advanced to a non-zero speed position; the ISD chip will begin playback at address 00h (the beginning) the bell.

When the direction is set in the reverse position and the throttle is advanced to a non-zero speed position; the ISD chip will begin playback at address 40h sounding only the whistles.

Either message will continue to loop as until the throttle is brought to zero.

If the throttle is at zero, no playback will occur and the direction can be toggled with no effect.

The permanent beginning addresses of the (2) messages will need to be defined prior to burning the Z86E08's.

The bells should be recorded in a perfect 4 or 8 count cadence for seamless looping.

The unit has been tested using stock Atheam trucks while moving.

The use of function bits and extended formats for sound triggering is being investigated.

The 2 PCB's DEC3A and DCCSND were modemed to the PC house on 1/1/95 and depending on their Holiday schedule will ship FEDEX either 1/6 or 1/13. 4 sets were ordered. They will come double-sided, plate-through, no masks, no silk screen, 1 oz. copper, .062" FR4. Each board is 4.65" x .9" and can be trimmed to .8" in width. The sandwich will be APPX. 1" high.

Would you please send programmed ISD1016 & NE575 chips ?? ;as I do not have a ready source.

item k

Design Notes:

The byte wide address read has been replaced with a multiplexed bit read. The dip switch has been eliminated

Several of the (J) connectors can be replaced with wire tails in order to keep packaging to a minimum.

The 7812 voltage regulator will probably need to be replaced with a 7809 as the DB100a booster does not put out sufficient voltage in all circumstances. (depends on input voltage & scale selection).

The front & rear lamps should probably be in the 5v 60ma range. The dropping resistors would then be APPX. 220 ohms. The higher the lamp voltage, the lower the resistor. The lower the resistor, the better the chance the transistor could be nuked if JC shorted the lamp leads.

The MOSFET transistors can drive inductive loads. (relays, motors, etc.)

Happy New Year !!!!!!!

Kelly KELLY

January 17 1996
Progress Report #6

Hey Mike !

Enclosed (2) NMRA DCC compatible decoders (DCC3A) & sound boards (DCCSND)

The first unit was a bear (the one I have) , the 2nd and 3rd went together effortlessly The extra few days allowed for improvements in the way the software operated

1 The original software (V1.0) triggered the bell and / or whistle for one complete playback whenever a valid DCC (on) transmission was received Sometimes this would result in a very brief, but in a rhythmic sense noticeable break when looping the bell while the processor waited for the next DCC transmission. The breaks were typically less than 0 1 second depending where the bell command was in the DCC bit stream. The current software (V1 1) continuously loops the bell once it receives a valid DCC (on) transmission, while it watches for the off command. This results in near seamless looping.

2. V1 1 has moved the bell toggle from F1 to F3 on the DT200 controller (Digitrax) even though the bell icon is attached to F1 This is due to Digitrax's use of F1 for the function feature in their Loco decoders. Optimally, it is intended that the sound unit be installed in a dummy "B" unit in conjunction with a powered "A" unit which is equipped with a DCC decoder Keeping F1 free makes it possible to install a beacon flasher in the "A" unit. An adhesive bell sticker could be included with the sound units to place below F3

3. V1.1 disregards the EOM signal This allows all of the functions to be updated while playback is occurring /CE will be continually retriggered but the ISD chip ignores any additional triggers until playback is completed. EOM is readable in the event it is required in a full sound system

4. The garbled sound problem has not occurred with the PC boards (Knock, Knock) It may be due to the greater width of the ground traces

5. V1.1 has been condensed to less than 1k of memory space This will allow the Z86E08 (2k OTP) to be replaced with the Z86E04 (1k OTP). The Z86E04 costs about $2.00 (100-1k lots) This is half of the cost of the E08

6 The NMRA specifies minimum timing ranges that a decoder must accept DCC data, but does not specify maximum tolerances I have established 80 microseconds as a divider between 1's & 0's The mean PW for a 1 is APPX. 60 micro sec and the minimum PW for a 0 is 100 micro sec. Using the 80 micro sec divider will allow reception from less than perfect boosters The error checking routines will weed out any bogus transmissions

7. V1.1 include use of the watchdog timer If the sound board "hangs" for more than 15 milliseconds (an eternity at 4MHz), the processor will automatically reset itself. This should help in the event of a glitch or dirty track conditions.

8 The address is read only at power-up. Any changes to the address or function jumpers will require a power-down / power-up sequence for recognition.

9 The volume control can be accessed with a jewelers screwdriver from the bottom. A "standup" 6mm pot could also be used for side access.

10 The decoder automatically switches between baseline 14, 28 step, & 128 step protocols. The decoder is not compatible with the "special 28" protocol.

11 There is no provision for operation on an analog layout.

12 The dropping resistors included for the lamps (160 ohm 1/2 W) are calculated as follows:

15 volt operating voltage
5 volt lamps 60 ma
Resistor must drop 10 volts

10v / .060 = 166.66 ohms

(.060)**2 x 160 = .576 watt

Areas for Contemplation

1. The diode jumpers are the least expensive and the most space efficient way to accomplish a multiplexed address. Will JC be able to handle the address setup? The address line route to Port 2 on the processor. Header jumpers were considered for address setup, but if JC turned the jumpers sideways, he could short port lines together. Dip switches costs $1.50 each. BCD switches cost $4.00 each (2 req.) Either type of switch takes up PCB real estate.

2. The 7809 / 7805 regulators run warm as do the dropping resistors for the lamps. Since they are on the outside of the board they could contact plastic Loco bodies. Some thought should be given to heat sinking. Some of the heat can be dissipated through wider traces on the PCB. The brass shim-stock is an example of a horizontal heat sink. The dropping resistors could be eliminated if full voltage (15v) lamps were used. (5v currently used). If the lamp leads were shorted when using a 15v lamp with no resistor, the driving transistor would certainly be shorted.

3. It may be possible to reduce the overall length of the PCB's by about 2".

4. The bell should be recorded in a perfect cadence for best looping. The bell seems to dominate the whistle due to its percussive nature.

5. Record Grade crossing sequences for horn and whistles (LLSL).

6. Include a defeatable automatic 2 toots or honks (3rd message) when a Locomotive starts moving. The automatic feature could be defeated by using an address bit position. This would reduce the addresses from 64 to 32. This should be a positive marketing feature as consumers expect to see automatic functions when processors are involved.

7. These boards should be able to accomplish your full sound system (1 message at a time) with different software.

Kelly,

Enclosed is a check for $300.00 for the associated costs of building the dual tone sound board.

Tuesday the 27 th we discussed the following topics: making the present design function with three sounds, converting the booster decoder to a full function decoder and will the consumer see a cost benefit to purchasing our sound products.

My only thought to including these in this note, is to put them on the table for further consideration. Addressing the first thought of expanding the board to three sounds is due to the fact that some one will want to activate both sounds at once. If this requires only a soft ware change. Then may be after we receive the input from the DCC manufacture we will attempt this change. After evaluating their suggestions, this may be the proper time to consider any changes.

Activation of the three sounds could be accomplished by using the throttle settings in base mode. The settings would be full throttle horn half bell, and at quarter setting bell and horn. These settings relating to the fact when the diesel is at speed the horn is used primarily and at half to low the bell and at low a combination of both are used.

As for the conversion to a full decoder from a booster I simply thought of it a means to provide another value added feature. This may especially may be worthy of more thought especially if the hardware is already in place and once again a software change may make it happen?

When we spoke on the phone we bicycle agreed that if enough features are in place and the sound quality is very high and if the product is needed then it should sell.

We also touched on a analog method of trigger this board and the method I would chose is using the Ott Lionel method which use the dc current overlaid on the ac track power to bicycle close a relay and turn the sound effect on. This would be defently a plus for the dual sound product to offer immediately

If any of these are impossible to accomplish without major revisions then let me know. Otherwise it would help if you would rank them on a scale of one to ten for difficulty.

I also mentioned to you a complete spread sheet would be helpful because then I could fax it out to the vendors I use for price quotes.

Best wishes
Mike

TERM

TRACK ADD LINES FOR MOTOR FUNCTIONS

1. FR H L
2. RL
3. DOUBLE
4. MOT F
5. MOT R
6. BELL
7. HORN

ADD SERIAL E² ROM FOR PROG ADDRESS

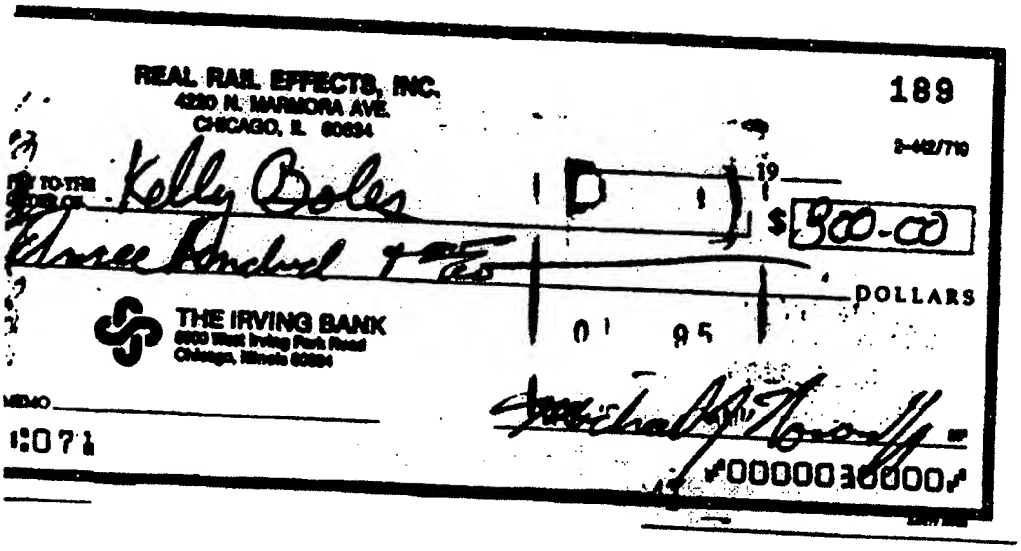
ADD MORE DRIVER TRANSISTORS

USE PICKUPS FROM A UNIT

WIRES
2 PICKUP
2 BEAM
2 LAMP
2 MOTOR

item 1

ENDORSE HERE Kelly Boles



Brian Mattson Esq
Hill, Steadman, & Simpson

September 23, 1994

The Following is a brief description of a device that I am contemplating. So I wish that this document be entered into my file at your law firm, for the purposes of recording this for a inception date.

The Device is for a model train sound system. The system will be composed of a couple different parts. The first is a means to rectifie track power and regulate it to a usable 5 Volts DC. The means to store audio data, play-back and amplifie the audio signal. The uniqueness of the device is in the fact that it combines non-syncronized train sounds and the varing metho to activate the bell and horn or whistle. Depending on if it is a steam or diesel locomotive and the engine sounds that each type makes.

The way the device will work is the locomotive sounds are recorded onto a ISD chip and use a micro-processor to syncronize the train sounds to the speed of the locomotive. The other sounds that the locomotives make then may be accessed through a host of different ways. This will depend on how the sound borad is equipped.

item m

8-4-95

Brian Mattson
Hill Steadman & Simpson
95 Th Sears Tower
Chicago, IL. 60606

Dear Brian,

You should have received the first diskette from me concerning the patent Real Rail Effects has filed with your help the number is p940008. Since the original filing date we have made some improvements and adapted the original sound board to another use within the model train industry.

This much you already know by the hand written note included with the original disk, and record of invention dated fall of 94'. The following is the technical description of how the device works, which is on the inclosed diskette.

In addition to the material on the disk we should keep in mind that the device is now smart. This due to the inclusion of a micro controller that may accept more than one operating system when programmed at the factory by us. Depending on the software written and imprinted on the micro controller. Different operating protocols may configure the sound unit to operating with other protocols and host system. Such as radio control or other digital type devices, a external input is included in the present design to accomplish these types of interfaces. These "other" operating system are yet to be defined in the marketplace. They could be obvious changes to the present design and should hopefully be covered either in the present language of the patent application or the revised application to cover our improvements.

As presently configured the sound unit will work with only one type of digital protocol, the NMRA DCC standard.

Let me add that another manufacture is presently selling a sound product based on the ISD chip. The company is called Ott machine services, as far as we can tell no application for a patent has been made. So there is prior art to look at, there are however major differences these are: the Ott product size is larger, operates off of a DC trigger imposed over AC track current, the audio compander is not included, accessory outputs are not present, no means to externally trigger the device off of a separate control input and cannot be adapted easily to other uses as ours can be

If you have any questions or in need of any material please contact me either at 312-202-9931 and leave a message or at 612-222-8469 in St. Paul. If these two numbers fail to reach me, you may also contact me through E-mail. My E-mail address is Real Rail@AOL.com.

Mike Novosel

item n